Feb. 19, 1935. W. M. LEEDS 1,991,901

CIRCUIT BREAKER

Filed March 18, 1932 2 Sheets-Sheet 1

Fig. 1.

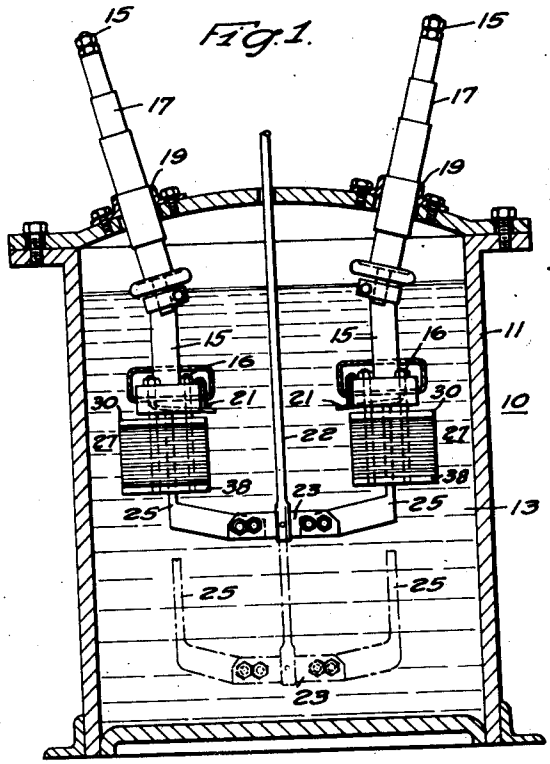


Fig. 2.

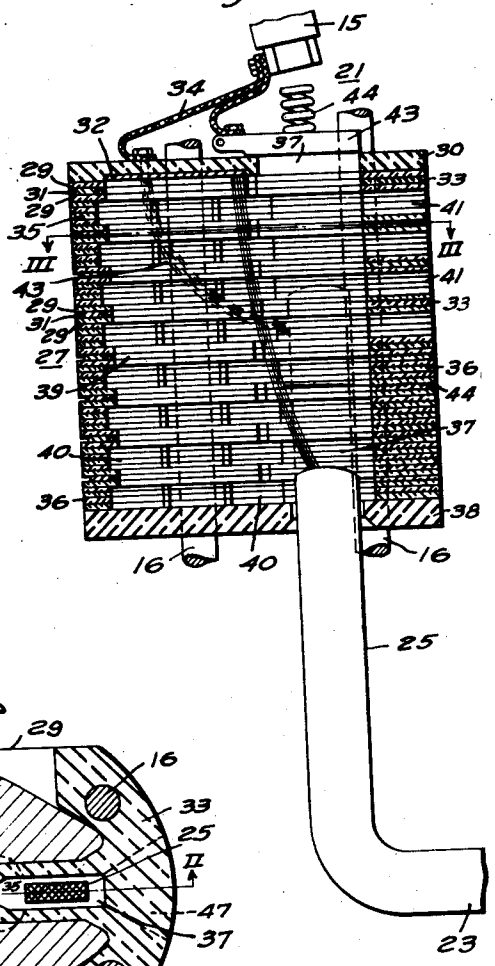


Fig. 3.

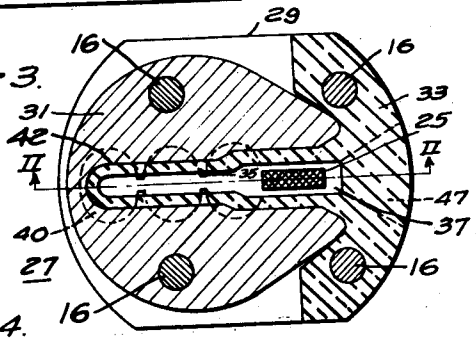
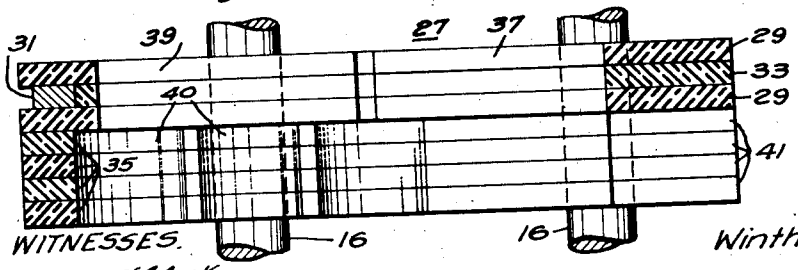


Fig. 4.



WITNESSES.

E. A. McCloskey.

Paul J. Glaister

INVENTOR

Winthrop M. Leeds.

BY F. W. Leyle.

ATTORNEY

Feb. 19, 1935. W. M. LEEDS 1,991,901

CIRCUIT BREAKER

Filed March 18, 1932 2 Sheets-Sheet 2

Fig. 5.

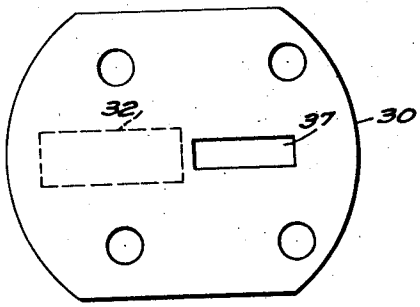


Fig. 8.

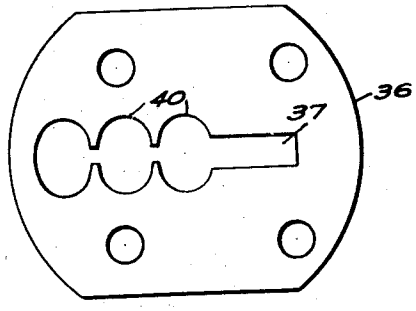


Fig. 6.

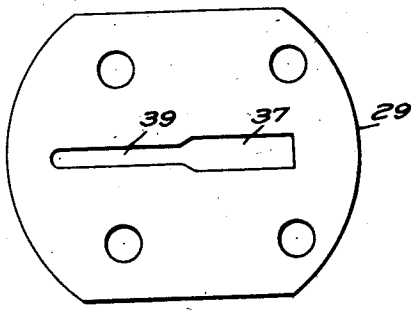


Fig. 9.

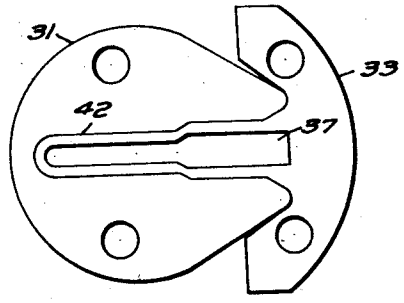


Fig. 7.

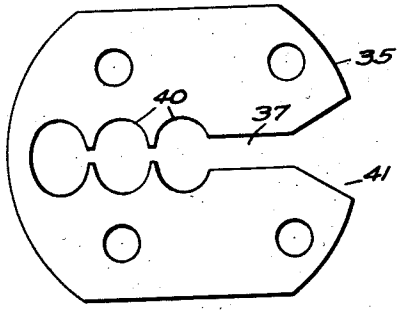
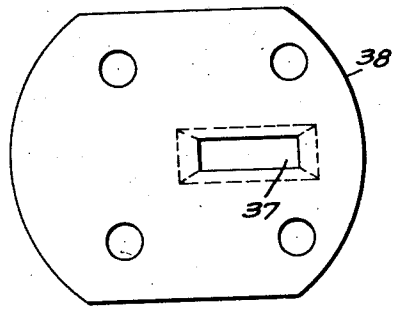


Fig. 10.



WITNESSES.
E. A. Mikelonis.
Paul J. Blaine

INVENTOR
Winthrop M. Leeds.
BY F. W. Leyde.
ATTORNEY

Patented Feb. 19, 1935 1,991,901

UNITED STATES PATENT OFFICE

1,991,901

CIRCUIT BREAKER

Winthrop M. Leeds, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, a corporation of Pennsylvania

Application March 18, 1932, Serial No. 599,678

18 Claims. (Cl. 200—150)

My invention relates to circuit interrupters and, more particularly, to circuit breakers in which arc extinguishers of the side-vented chamber type are provided for extinguishing the arc. This application is a continuation in part of patent application 510,990 of B. P. Baker and W. M. Leeds, filed January 24, 1931, and assigned to the assignee of this application.

This type of arc extinguishing structure usually comprises a stack of plates of insulating material between which are placed a plurality of plates of magnetic material at spaced intervals. Aligned slots are provided in both the insulating plates and the iron plates forming an elongated groove within which the arc is drawn. The arc is moved laterally in the groove, due to the distortion of the magnetic field around the arc by the magnetic plates, in contact with the edges of the insulating plates which retain oil adjacent the arc path. This oil is decomposed giving off a large volume of gas which passes turbulently through the arc stream to deionize the arc and prevent its reignition after the first zero point on the alternating current wave.

One object of my invention is to provide means for securing equally satisfactory operation of an arc extinguishing structure of this type on both heavy and moderate currents.

Another object of my invention is to generally improve the operation of existing arc extinguishing structures of the general type herein described.

A further object of my invention is to provide novel means for venting arc extinguishing structures, which means shall improve the operation of said structure.

In previous structures of this type it has been observed that it is easier to extinguish the arcs caused by heavy currents than those caused by moderate currents. This apparent phenomenon may be explained when the action of the arc extinguisher structure is examined.

When a high current is being interrupted, the arc energy is high. This results in a large quantity of oil being decomposed to supply a large volume of gas to extinguish the arc. The amount of gas available for deionizing the arc is further increased with high current arcs since the resultant electro-magnetic forces exerted by the slotted magnetic plates, tending to move the arc further into the deionizing structure, are very large. As a result, the arc is quickly forced into the slots where it is moved into contact with fresh volumes of oil giving a continuous supply of gas to deionize the arc. Tests indicate that these heavy current arcs are extinguished in the upper portion of the arc extinguishing structure before the arc is drawn the full length of the stack of plates. With moderate current arcs, however, an insufficient quantity of gas is generated to extinguish the arc at once and the magnetically produced forces are weak, with the result that the arc moves comparatively slowly into the arc extinguishing structure and is drawn to a greater length before it is extinguished.

With my invention, I have suceeded in overcoming these difficulties at lower currents and have produced a structure which operates better than the previous structures on low values of arc current and equally as well on heavier currents. These advantages are secured by the novel arrangement which I employ in the construction and venting of the arc extinguishing structure. Specifically, I vent the arc extinguishing structure in the upper part of its length, where the arc is first drawn, and restrict or entirely omit vents in the lower part. In operation these restricted vents cause a confinement of the gases produced by the arc within the structure, and by having the groove without vents at the lower portion of the stack of plates, the gases formed within the lower portion of the structure are caused to flow upwardly and longitudinally through the arc, thus making more effective use of smaller amounts of gas generated to deionize the arc.

These and other objects and advantages of my invention will be made further apparent from the following description of the accompanying drawings, in which:

Figure 1 is a sectional view through a circuit breaker embodying my invention, showing the interior parts in elevation;

Fig. 2 is a sectional view of the stack of deionizing plates, taken on the line II—II of Fig. 3;

Fig. 3 is a sectional view through the stack of deionizing plates taken on the line III—III of Fig. 2;

Fig. 4 is an enlarged sectional view of one of the vented groups shown in Fig. 2, the thickness of the plates has been exaggerated for clearness;

Figs. 5, 6, 7, 8, 9 and 10 are plan views showing the individual plates which comprise the arc extinguishing structure.

Referring to Fig. 1, the circuit breaker 10 comprises a liquid-tight tank or container 11, which is filled with oil or other insulating liquid 13. Current conductors 15 extend through insulating bushings 17 which are secured by flanged

collars 19 to the top of the tank or container 11. The lower end of each of the conductors 15 is provided with a stationary contact structure 21. Electrical connection is made between the contacts 21 by means of a conducting bar 23 having upstanding tips 25. The conducting bar 23 is actuated to open or close the circuit breaker through an operating rod 22 by a suitable mechanism (not shown).

A stack of deionizing plates 27, held together by retaining means such as bolts 16, is secured to the ends of the conductors 15. The arc extinguishing structure is formed by assembling a plurality of groups of the plates shown in Figs. 5, 6, 7, 8, 9, and 10, each of said groups of plates comprising a pair of fibre plates 29 having therebetween a slotted plate 31, of magnetic material and a lining member 33 of fibre, and spacing plates 35 or 36 of fuller-board or other insulating material. The plates 35 are used to secure the vented groups, and the plates 36 are used for the unvented groups. The top insulating plate 30 includes a slot 37 to permit the passage of the contact tip 25 when making contact with the main contact 43, and an arcing contact 32 connected by a shunt 34 to the conductor 15. On the bottom of the stack, a second similarly slotted insulating plate 38 is affixed.

The fibre plates 29 have a slot 39 extending from the wider slot 37 which is common to all the insulating plates of the structure. The plates 35 and 36 have recesses 40 arranged in the extension of slot 37 for the purpose of retaining oil along the arc path where it will be decomposed to supply gas for deionizing the arc. The plates 35 which space the groups of iron and fibre plates at the top of the stack have an additional slot 41 extending to the outer edge thereof which vents the groove formed by slots 37 on assembly. The effect of the slot 42 in the magnetic plate 31 is to cause the magnetic field set up by the arc to force the arc into slot 39. The fibre lining 33, which is placed within the slot 42 of the plates 31, protects the edges of the slot in each of the plates 31 from the arc.

The main contact member 43 is biased downwardly by spring 44 so as to close the opening 37 in the top plate 30 after the withdrawal of the contact tips 25 thereby effectively sealing the top of structure 27. Also, since the slot 37 is the only opening in the bottom plate 38 and since it is closed by the moving contact 25, substantially all of the gases formed by the arc must be vented through the slots 41 in the plates 35 in the top half of the stack. Thus, the gases formed in the groove resulting from the assembly of the plates, all of which have the similar slot 37, are forced to flow longitudinally through the arc, especially when the arc is drawn into the lower portion of the groove. The increased gas generation and the large magnetic forces accompanying a heavy current arc result in the complete and rapid extinguishment of that arc in the top part of the structure adjacent to the vents. The lines 43 and 44 illustrate the paths taken by high and medium current arcs, respectively, very shortly after the arcs are established. The force of the magnetic field transfers the arc almost immediately to the arcing contact or horn 32, and it becomes apparent that even the relatively long, moderate current arc makes effective use of the gases generated due to the longitudinal flow therethrough, thus compensating for the weaker magnetic action and the smaller volume of gas.

While a liquid circuit breaker has been shown in the drawings, I do not wish to limit my invention to that type of circuit interrupter, because the broad idea is applicable to other types as well.

Also, while the foregoing specification has described how my invention might be applied to one specific type of arc extinguishing structure, I do not wish to limit myself to that type of structure except in the manner specified in the following claims.

I claim as my invention:

1. In an arc extinguishing structure for a circuit interrupter, a groove, means for causing an arc in said groove, said groove being closed on the end where said arc is drawn, plates of magnetic material adjacent to said groove for moving said arc in said groove, and means for venting said structure only in the neighborhood of said closed end.

2. In an arc extinguishing structure for a circuit interrupter, a body of liquid, a groove, a fixed contact and a movable contact for drawing an arc in said groove, plates of magnetic material adjacent to said groove for moving said arc in said groove, and means for venting said structure on the side at the end adjacent said fixed contact only.

3. In a circuit interrupter, an arc extinguishing structure, said structure including a plurality of groups of plates, each group including an insulating plate and a plate of magnetic material, said plates having aligned slots forming a groove in which said arc is drawn, means for closing one end of said groove, and means for venting said structure on the side only in the neighborhood of said closed end.

4. In a circuit interrupter, a body of liquid, means for establishing an arc, an arc extinguishing structure, said structure including a plurality of groups of plates, each group including an insulating plate and a plate of magnetic material, said plates having aligned slots forming a groove in which said arc is drawn, means for closing one end of said groove, and means for venting said structure only adjacent to the end of said groove where the arc is initially established.

5. In an arc extinguishing structure for a circuit interrupter, a plurality of slotted plates arranged in groups of two or more insulating plates and one iron plate, said slots aligning to form a groove within which said arc is drawn, the transverse length of said groove being several times its transverse width, and means for venting said groove along one side only in that portion where the arc is initially drawn.

6. In a circuit interrupter, an arc extinguishing structure, said structure including a plurality of groups of plates, each group including a pair of plates of insulating material having slots therein, a plate of magnetic material having a slot therein interposed between said insulating plates, and a plurality of plates of insulating material having slots therein and recesses along said slots, said slots in all of said plates being aligned to form a groove in which said arc is drawn, said groove being vented along one side thereof in that portion where the arc is intially drawn and being unvented along the remaining portion of said side.

7. In a circuit interrupter, a body of liquid, an arc extinguishing structure, said structure including a plurality of groups of plates, each group including a pair of plates of insulating ma-

terial having slots therein, a plate of magnetic material having a slot therein interposed between said insulating plates, and a plurality of plates of absorbent material having slots therein, said slots all being aligned to form a groove in which said arc is drawn, and means for venting said structure along one side, only in that portion where the arc is initially drawn.

8. In a circuit interrupter, an arc extinguishing structure, said structure including a plurality of groups of plates, each group including a pair of plates of insulating material having slots therein, a plate of magnetic material having a slot therein interposed between said insulating plates, an insulating strip between said insulating plates for protecting the edge of said magnetic plate from the arc, the slots in said insulating and magnetic plates being aligned to form a groove in which said arc is drawn, means for closing one end of said groove, and means for venting said structure along one side, only in that portion where the arc is initially drawn.

9. In a circuit interrupter, a body of liquid, an arc extinguishing structure, said structure including a plurality of groups of plates, each group including a pair of plates of insulating material having slots therein, a plate of magnetic material having a slot therein interposed between said insulating plates, an insulating strip between said insulating plates for protecting the edge of said magnetic plate from the arc, and a plurality of plates of fibrous insulating material having slots therein, said slots all being aligned to form a groove in which said arc is drawn, means for venting some of said groups and other of said groups being unvented, and all of said vented groups being assembled in that portion of the structure where the arc is initially drawn.

10. In a circuit interrupter, a body of liquid, a fixed contact and a movable contact for drawing an arc in said liquid, and an arc extinguishing structure, said structure including a plurality of groups of plates, each group including a pair of plates of insulating material having slots therein, a plate of magnetic material having a slot therein interposed between said insulating plates, an insulating strip between said insulating plates for protecting the edge of said magnetic plates from the arc, a plurality of plates of absorbent material having slots therein and recesses along said slots, said slots all being aligned to form a groove in which said arc is drawn, means for closing one end of said groove, means for venting some of said groups to one side thereof, other of said groups being unvented, said vented groups being all assembled in that portion of the structure adjacent to said fixed contact.

11. In a circuit interrupter, means at least partly of insulating material for defining a passage, means for establishing an arc within said passage, magnetic means for moving said arc in said passage, said passage being substantially closed on the end where said arc is initially established, and means for venting said passage only in the neighborhood of said closed end.

12. In a circuit interrupter, means for defining a passage that is lined with insulating material, means for establishing an arc within said passage, means of magnetic material for moving said arc in said passage, said passage being substantially closed on the end where said arc is initially established, and means for venting said passage only in the neighborhood of said closed end.

13. In a circuit interrupter, means defining a passage, means for establishing an arc within said passage, means including members of magnetic material for moving said arc in said passage, said passage being substantially closed on the end where said arc is initially established, and means for venting the side of said passage only adjacent said closed end.

14. In a circuit interrupter, means of insulating material defining the walls of a chamber having a centrally disposed passage extending therethrough, means for establishing an arc within said passage, means for closing said passage at the end where said arc is initially established, means of magnetic material imbedded in the walls surrounding said passage for moving said arc in said passage, and means for venting one side of said passage only in the neighborhood of said closed end.

15. In a circuit interrupter, a chamber having walls of insulating material and a centrally disposed passage extending therethrough, a stationary contact means positioned at one end of said passage and a contact member movable through said passage to establish an arc therein, said stationary contact means being adapted to substantially close one end of said passage, said movable contact member being adapted to close the other end of said passage while establishing said arc therein, means of magnetic material imbedded in the walls of said chamber and insulated from said passage for moving the arc in said passage, and means for venting one side of said passage only adjacent said stationary contact.

16. In a circuit interrupter, means at least partly of insulating material for defining a passage, means for establishing an arc within said passage, magnetic means for moving the arc in said passage, and means, disposed adjacent one end of said passage, for venting said passage, and means for causing a considerable portion of the arc products to flow substantially longitudinally of said passage.

17. In a circuit interrupter, means at least partly of insulating material for defining a passage, means for establishing an arc within said passage, means of magnetic material for moving the arc in said passage, and means for venting said passage, and means for causing considerable portion of the arc products to flow substantially longitudinally of said passage toward said venting means.

18. In a circuit interrupter, means at least partly of insulating material for defining a passage, means for establishing an arc within said passage, magnetic means for moving said arc in said passage, said passage having a vent adjacent the end thereof where said arc is initially established, and said means of insulating material defining the passage causing a major portion of the arc products to flow in said passage toward said end where the arc is initially established.

WINTHROP M. LEEDS.